

## FASTENING ASSEMBLY

## Background Information

The present invention is based on a fastening assembly according to the definition of the species in the independent claim.

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Patent EP 898 087 B1 describes a fastening assembly according to a keyhole principle, in which a bolt used for fastening has engagement surfaces for a tool at both ends. This unusual bolt makes it possible to clamp the fastening assembly from both ends.

- 10 The disadvantage of the design approach presented in EP 898 087 B1 is that this unusual bolt is necessary for fastening.

The objective of the present invention, therefore, is to provide a fastening assembly that avoids this bolt.

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## Summary of the Invention

- By contrast, the fastening assembly according to the present invention having the features of the independent claim has the advantage that now the bolt has a round head having a smooth surface and that hence a simpler bolt or an alternative fastening assembly is possible. This bolt is in particular more advantageous to manufacture, since on the one hand the engagement surface for the tool is eliminated, thus requiring fewer work steps for manufacturing the bolt, and also because the head can now be designed to be thinner than would be necessary in the case of a head that has an engagement surface. This saves material and hence also costs. The preassembly process of screwing in this bolt having only one engagement surface is neutral as regards costs compared to the bolt having two engagement surfaces, so that thereby the cost advantage gained by the simpler bolt is not reduced.

The measures and refinements specified in the dependent claims permit advantageous improvements of the fastening assembly indicated in the independent claim.

Especially advantageous is the fact that the engagement surface at the end of the bolt takes  
5 the form of a specific external toothing, for example TORX, or of an external polyhedron, as  
in an Allen bolt, for example. TORX denotes a star-shaped toothing. Allen is a common  
name for a hexagon. Alternatively, it is also possible to use an internal toothed socket or an  
internal polyhedron. These designs allow for a precise screw-in operation. In this context the  
10 use of a left-hand thread is particularly advantageous. This is advantageous, since clockwise  
rotating tools are normally used in the automotive industry. The screw-on process occurs on  
the side of the external toothing or the external polyhedron, so that in this case a screw-on  
process is effected by a clockwise rotation of the tool. Furthermore, the bolt is  
advantageously designed to be self-locking. This is to hold the bolt in place following  
preassembly. The bolthead then has the specified clearance with respect to the housing,  
15 which allows for the hooking into the keyhole. In the subsequent screw-on process,  
self-locking is overcome and the bolt is tightened as far as the end stop. Self-locking may be  
implemented, for example, by a coating over a subsection or over the entire length of the  
thread.

20 Furthermore, it is advantageous that the fastening assembly according to the present  
invention has a rotation guard as well as a translation guard. On the one hand, this facilitates  
the installation of the fastening assembly according to the present invention, while on the  
other hand securing the first component fastened to the second component against rotational  
or translational movements, so that the first component, for example the sensor housing,  
25 always remains in the correct position in the keyhole. This is achieved by projections, which,  
once the components have been assembled through the keyhole, block rotational and  
translational movements. The projections are provided in the housing in such a way that they  
extend with a precise fit into the keyhole and thereby prevent a movement. It is also possible  
30 to design the projections in such a way that the first component has just a small amount of  
play. This is advantageous particularly also during the fastening process so as to simplify this  
work step.

Brief Description of the Drawing

Exemplary embodiments of the present invention are shown in the drawing and are explained in greater detail in the following description.

5 The figures show:

Figure 1 a first component of the fastening assembly according to the present invention including a bolt,

10 Figure 2 the fastening assembly in an assembled state,

Figure 3 the second component of the fastening assembly according to the present invention in a top view,

15 Figure 4 a side and rear view of the fastening assembly according to the present invention,

Figure 5 a view of the bolt of the fastening assembly according to the present invention and

Figure 6 a side view of the bolt as an engineering drawing.

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## Description

In the automotive industry, components, particularly sensors, for restraining systems for example, are fastened to the vehicle in various ways. Apart from screwing the component to a  
25 nut welded into the vehicle body or screwing the component via a hole in the vehicle body into a threaded bushing of the component using a bolt, the keyhole principle is increasingly used for fastening housings. For this purpose, bolts, preassembled and held in place by self-locking in a housing of the component to be mounted, are guided head first into the larger part of a keyhole-like cut-out in the vehicle body and are then hooked into the lower,  
30 narrower part, i.e. a further opening of the keyhole. The bolt is then tightened and the component thereby clamped.

In contrast to the two other methods mentioned above, the keyhole principle has the advantage that on the one hand no nut needs to be welded into or otherwise preinstalled in the vehicle, which represents a significant cost advantage. On the other hand, as in the case where a bolt is screwed through according to the keyhole principle, it is not necessary to have access from both sides of the screw-on point. This makes it possible, for example, to hook and screw a sensor onto a hollow B column, which is no longer accessible from the outside, thus making the choice of the screw-on location more flexible.

According to the present invention, a fastening assembly is now provided, which has a bolt, the head of which is round and has a smooth surface. At the end of its shank, this bolt has engagement surfaces for a tool, preferably an external toothing or an external polyhedron. The bolt has a round head of variable thickness, which does not have an engagement surface for a tool. This is followed by the shank, the end of which has an engagement surface for a tool. The bolt shank itself has, over a subsection or its entire length, a thread for screwing it into a matched bushing of the housing of the component that is to be screwed on. Preferably, a left-hand thread is used for this purpose, since in the automotive industry clockwise rotating tools are normally used. The screw-on process occurs on the side of the external toothing or the external polyhedron, so that in this case a screw-on process is effected by a clockwise rotation of the tool. Furthermore, the bolt is designed to be self-locking. This is to hold the bolt in place following preassembly. The bolthead then has the specified clearance with respect to the housing, which allows for the hooking into the keyhole. In the subsequent screw-on process, the self-locking is overcome and the bolt is tightened as far as the end stop. Self-locking may be implemented, for example, by a coating over a subsection or over the entire length of the thread. The coating is a so-called jamming coating as is described for example in DIN 267 part 28. The coating is made of synthetic material, which causes a jamming action in the course of the screw-in process. The jamming coatings can be implemented as all-around coatings, striated coatings or spot coatings. They cannot stop the unscrewing of the connection, but they prevent a complete detachment. As material for the coating, polyamide, GESI-P7, Clemm-LOC, VC3-Vibratite or similar [substances] may be used.

Figure 1 shows the view of a part of the fastening assembly according to the present invention. Here a housing 1 of a sensor, in this case of a side-impact sensor, is represented as

the first component, from which a head 2 of a bolt protrudes, above which a rotation guard 3 is located, the housing additionally featuring a translation guard 4. The rotation guard and the translation guard are designed as appropriately formed projections, which in a fastened state prevent housing 1 from turning or shifting.

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Housing 1 has spaces for receiving the electronic equipment, ribbing for reinforcement and for mechanical identification in the production line, translation guard 4 having the form of a flange, which will press against an edge of a cut-out of the keyhole so as to prevent a translation movement. This flange 4 presses against the opposite end of the cut-out as compared to the bolt, which engages behind the smaller opening of the keyhole with head 2. That is to say, flange 4 presses against the edge of the larger opening through which head 2 is insertible. Here flange 4 has a rounded surface, which will press against the edge of the cut-out. Rotation guard 3 is shaped in such a way that it wedges at the interface between the large and the small opening of the keyhole so as to prevent a rotation of housing 1 when housing 1 has been inserted into the keyhole and clamped. Housing 1 has been manufactured for example from metal and/or plastic. As shown here, head 2 of the bolt is round and has a smooth surface. Merely the bolting direction and a marking may be applied on head 2.

Figure 2 now shows housing 1 as it has been fastened in a keyhole, which is produced as a cut-out in a panel 5. The keyhole features a larger opening 6, through which head 2 may be guided. For fastening, housing 1 is then guided with head 2 downward so as to insert head 2 into the smaller opening 7 since head 2 due to its size engages behind this smaller opening 7, thereby allowing for clamping by tightening the bolt. Openings 6 and 7 thus merge into each other and are not separated from each other.

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Here it is also shown how rotation guard 3 reaches the clamping at the interface between large opening 6 and small opening 7 and how translation guard 4 presses against the edge, namely exactly in the opposite direction to bolt 2, in order to prevent translational movements in the longitudinal direction of the keyhole.

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In a top view, Figure 3 shows panel 5, which may be part of a body shell, with the keyhole, that is, with large opening 6 and small opening 7. Typical dimensions are indicated here by way of example. Upper opening 6 has essentially a circular shape, while lower opening 7

takes the form of a rectangular cut-out. Alternatively, it is also possible for openings 6 and 7 to be formed hexagonally or elliptically.

The width of rectangular cut-out 7 is such that the bolthead can engage behind this opening.

- 5 The diameter of larger opening 6, however, is dimensioned in such a way that head 2 may be guided through it. This then allows for a simple installation of housing 1, for example a sensor housing, during assembly at an automobile manufacturer.

- 10 Figure 4 shows the side view and a rear view of fastened housing 1. In the side view, housing 1 is fitted with a cover and is bolted by bolt 2 to panel 5 having the keyhole opening. Additionally, translation guard 4 and rotation guard 3 are shown protruding through the keyhole. In the rear view, an external TORX 20 is shown as an engagement surface for a tool to tighten the bolt from behind in such a way that it brings about a clamping against panel 5. Shown here as well is a rear view of translation guard 4, which is reinforced by ribbing. The  
15 direction of rotation of external TORX 20 here indicates a clockwise rotation. This rotation is indicated by reference numeral 8. Instead of the external TORX, it is also possible to choose other external toothing or external polyhedron forms.

- 20 Figure 5 shows a representation of the bolt belonging to the fastening assembly according to the present invention. The bolt features external TORX 20 and round head 2. In addition, the bolt has a bolt shank 10 featuring a thread in a specified area. The thread may span the entire bolt shank 10. Here the area that is represented as somewhat thinner is free of a thread. This has the advantage that in the preassembly of the bolt only a short section of thread has to be screwed into the bushing. The smooth part of the shank can simply be guided through the  
25 bushing. This saves screw-in time and hence costs.

- Figure 6 again shows the bolt in a side view. External TORX 20 and the thread are shown here and are marked with typical dimensions. Additionally, thread area 12 features an area for a jamming coating for securing the position of the bolt. Polyamide may be  
30 advantageously used for this purpose.

Furthermore, it is possible to provide a star-shaped toothing at head 2, which represents an additional guard against a loosening of the bolt after the bolt has been tightened as far as the end stop during assembly at the screw-on location.

- 5 The fastening assembly according to the present invention is now fastened in that first the bolt having head 2 is screwed into housing 1 in such a way that head 2 still protrudes a fair bit. Head 2 is then guided through large opening 6 of the keyhole and device 1 with head 2 is moved in a translatory manner in such a way that head 2 engages behind opening 7. Via the external toothing or external polyhedron 20, housing 1 may then be fastened to panel 5. As
- 10 shown above, in thread area 12, the bolt features self-locking based on a coating, which is overcome by screwing the bolt onto panel 5. Self-locking may also be implemented through the use of a thread-forming bolt.